NASA SBIR/STTR Technologies

H2.02-9810 - Acoustic Resonance Reaction Control Thruster (ARCTIC)

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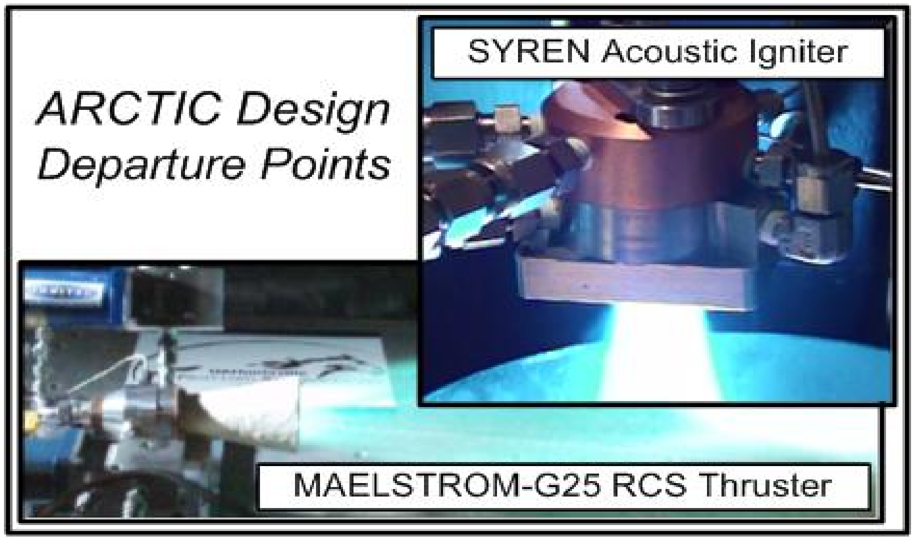
Identification and Significance of Innovation

ORBITEC proposes to develop and demonstrate the innovative Acoustic Resonance Reaction Control Thruster (ARCTIC) to provide rapid and reliable in-space impulse without the use of toxic hypergols, delicate catalyst beds, or cumbersome spark systems. The ARCTIC thruster will exceed current reliability standards, reduce RCS complexity, and provide system-level benefits by minimizing weight, decreasing power requirements, and improving serviceability. The Phase I work will focus on the development and testing, both at sea level and vacuum conditions, of a prototype ARCTIC thruster, as well as the design of flight-weight ARCTIC thruster for Phase II implementation.

Estimated TRL at beginning and end of contract: (Begin: 3 End: 5)



Technical Objectives and Work Plan

Task 1. Determine the propellant combinations and operating conditions that are most in-line with NASA's long-range exploration goals. Operating conditions of interest for the ARCTIC will include thrust level, chamber pressure, minimum impulse bit, and thruster duty cycle. (Unless otherwise directed by the NASA technical monitor, the thruster will be sized to deliver 25 ? 35 lbf of vacuum thrust at 200 psia with oxygen and hydrogen)
Task 2. Use the results from a previous experimental and computational studies of ORBITEC's nozzle-cavity to guide the design of a modular boilerplate version of the acoustic resonance thruster (ARCTIC-1) for sea-level and vacuum operation
Task 3. Integrate the ARCTIC-1 into ORBITEC's Small-Scale Test Facility and characterize the resonance heating in a series of driver gas "cold-flow" tests.
Task 4. Demonstrate quick thruster response, small minimum impulse bit, and repeatable, multi-use operation with the ARCTIC-1 at sea-level conditions. Determine the sensitivity of ARCTIC-1 to shifts in mixture ratio, supply pressures, and propellant temperature including cold-soak/cryogenic temperatures
Task 5. Demonstrate appropriate ignition response at simulated altitude conditions of 100,000 ft
Task 6. Work closely with the NASA technical monitor to design a flight-weight thruster (ARCTIC-2) for fabrication and testing in Phase II.

NASA Applications

ARCTIC addresses the needs in NASA's technology roadmap, specifically Technology Area 1.4.1, which calls for low-cost, high thrust-to-weight RCS thrusters that use non-toxic propellants. By eliminating cat beds, hypergols, and spark systems, ARCTIC will be developed into a safe, low-cost, long-life RCS thruster to support NASA's exploration activities. This versatile thruster can be used with a wide range of fluids, including indigenous spacecraft propellants and in situ space resources.

Non-NASA Applications

Beyond the needs of NASA, it is expected that ARCTIC-based propulsion systems could be developed for governmental customers such as the USAF's Reusable Booster System (RBS) program as well as commercial customers such as Sierra Nevada's Dream Chaser program and Boeing's Cryogenic Propellant Storage and Transfer demonstrator. The same acoustic resonance technology could be used in applications inc

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